JC03 Rec'd PCT/PTO 10 DEC 2001

FORM PTO-1390 (REV. 9-2001) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY 'S DOCKET NUMBER: P/3240-65

U.S. APPLICATION NO. (If known, see 37 CFR 1.5: 10/009410

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/04304	11 May 2000	8 June 1999

TITLE OF INVENTION: PROCESS FOR CONDITIONING SLAGS, AND INSTALLATION FOR THIS PROCESS

APPLICANT(S) FOR DO/EO/US: Hermann PIRKER

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [ ] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [X] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   - b. [X] has been communicated by the International Bureau.
   - c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   - a. [X] is attached hereto.
   - b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [ ] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   - b. [ ] have been communicated by the International Bureau.
   - c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   - d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). – unsigned
10. [X] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordan
18. [ ] A second copy of the published international application und
19. [ ] A second copy of the English language translation of the inte
20. [X] Other items or information:
    3 sheets of drawings.
    5 references.
    Print PEFS form.

EXPRESS MAIL CERTIFICATE

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail Post Office Addressee (Mail Label EL 924390225US US) in an envelope addressed to: U.S. Patent and Trademark Office, PO Box 2327, Arlington, VA 22202, on December 10, 2001

Dorothy Jenkins

Name of Person Mailing correspondence

Dorothy Jenkins

Signature

December 10, 2001

Date of Signature

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U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 10/009410	INTERNATIONAL APPLICATION NO PCT/EP00/04304	ATTORNEY'S DOCKET NUMBER P/3240-65

	CALCULATIONS	PTO USE ONLY
21. [x] The following fees are submitted: **BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):** Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO .... **$1040.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO .... **$890.00** International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... **$740.00** International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) .... **$710.00** International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	21 - 20 =	1	x **$18.00**	$ 18.00	
Independent claims	1 - 3 =	0	x **$84.00**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$280.00**	$	
TOTAL OF ABOVE CALCULATIONS =				$ 908.00	
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. +				$	
SUBTOTAL =				$ 908.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
TOTAL NATIONAL FEE =				$ 908.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 908.00	
				Amount to be refunded:	$
				charged:	$

a. [x] A check in the amount of $ 908. to cover the above fees is enclosed. **Check No.** 7671

b. [ ] Please charge my Deposit Account No. ________ in the amount of $ ________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 15-0700 . A duplicate copy of this sheet is enclosed.

d. [ ] Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

OSTROLENK, FABER, GERB & SOFFEN, LLP
1180 Avenue of the Americas
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Tel: (212) 382 0700

SIGNATURE

Max Moskowitz
NAME

30,576
REGISTRATION NUMBER

10/009410

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P/3240-65

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

Hermann PIRKER — Date: December 10, 2001

International Appln. No. PCT/EP00/04304 — International Filing Date: May 12, 2000

Serial No.: — Group Art Unit:

Filed: — Examiner:

For: PROCESS FOR CONDITIONING SLAGS, AND INSTALLATION FOR THIS PROCESS

Asst. Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Preliminary to examination, please amend as follows:

FEE CALCULATION

Any additional fee required has been calculated as follows:

_____ If checked, "Small Entity" status is claimed.

	NO. CLAIMS AFTER AMENDMENT		HIGHEST NO. PREVIOUSLY PAID FOR		EXTRA PRESENT		RATE		ADDIT. FEE
TOTAL	21	MINUS		* =	1	X	($9 SE or $18)	$	18
INDEP.	1	MINUS		** =	0	X	($42 SE or $84)	$	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM						X	($140 SE or $280)	$	
* not less than 20 ** not less than 3							TOTAL	$	18

If any additional payment is required, a check which includes the calculated fee of $ 18 (OFGS Check No. 7671) is attached.

In the event the actual fee is greater than the payment submitted or is inadvertently not enclosed or if any additional fee during the prosecution of this application is not paid, the Patent Office is authorized to charge the underpayment to Deposit Account No. 15-0700.

CONTINGENT EXTENSION REQUEST

If this communication is filed after the shortened statutory time period had elapsed and no separate Petition is enclosed, the Commissioner of Patents and Trademarks is petitioned, under 37 C.F.R. § 1.136(a), to extend the time for filing a response to the outstanding Office Action by the number of months which will avoid abandonment under 37 C.F.R. § 1.135. The fee under 37 C.F.R. § 1.17 should be charged to our Deposit Account No. 15-0700.

AMENDMENTS

✔ If checked, amendment(s) to the specification and/or claims are submitted herewith.

1. Claims:

Please amend claims 3-16, 20 and 21, and add new claim 17 pursuant to 37 C.F.R. § 1.121(c)(i) as set forth in the "clean" version attached hereto as Appendix A. Entry is respectfully requested. A version with markings to show the changes made pursuant to 37 C.F.R. § 1.121(c)(ii) is attached hereto as Appendix B.

REMARKS/ARGUMENT

This Preliminary Amendment is being submitted to change the multiple dependent claims to single dependent claims to eliminate the improper multiple dependent claims and to reduce the government filing fee.

EXPRESS MAIL CERTIFICATE

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail to Addressee (mail label #EL 924390225US) in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on December 10, 2001:

Dorothy Jenkins
Name of Person Mailing Correspondence

Dorothy Jenkins
Signature

December 10, 2001
Date of Signature

Respectfully submitted,

Max M

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APPENDIX A

"CLEAN" VERSION OF EACH PARAGRAPH/SECTION/CLAIM
37 C.F.R. § 1.121(b)(ii) AND (c)(i)

CLAIMS (with indication of amended or new):

(Amended) 3. The process as claimed in claim 1, characterized in that the converter slag is introduced into the slag-conditioning vessel (38) in the liquid state.

(Amended) 4. The process as claimed in claim 1, characterized in that the melting of solid charge materials in the slag melt, the introduction of energy for heat-consuming chemical reactions and the heating of the melts (26, 30) contained in the slag-conditioning vessel (38) to a suitable temperature are carried out by the introduction of electrical energy.

(Amended) 5. The process as claimed in claim 1, characterized in that the slag melt (30) contained in the slag-conditioning vessel (38) is oxidized in order to be desulfurized, preferably by blowing in oxygen and/or by blowing in an oxygen-containing gas, such as air.

(Amended) 6. The process as claimed in claim 1, characterized in that the metallurgical remainder materials (6) are added to the slag melt (30) in the slag-conditioning vessel (38) in the form of lumps and/or fine pieces.

(Amended) 7. The process as claimed in claim 1, characterized in that finely particulate metallurgical remainder materials (6) are blown into the slag melt (30) and/or the iron melt (26) below it at a low level, preferably lower than 2 m.

(Amended) 8. The process as claimed in claim 1, characterized in that finely particulate metallurgical remainder materials (6) and reducing agents (23) are blown into the slag-

conditioning vessel (38) through a common delivery line and/or lance (47) by means of co-injection.

(Amended) 9. The process as claimed in claim 1, characterized in that the slag-conditioning vessel (38) is heated by means of electrical resistance heating.

(Amended) 10. The process as claimed in claim 1, characterized in that a layer of slag (30) which is over 1 m high, preferably from 2 to 5 m high, is maintained in the slag-conditioning vessel (38).

(Amended) 11. The process as claimed in claim 1, characterized in that the desiliconization slag (25) from the pig iron conditioning is introduced into the slag-conditioning vessel (38).

(Amended) 12. The process as claimed in claim 1, characterized in that the metallurgical remainder materials (6) from all operations in the metallurgical plant are prepared by screening, milling, drying and the like in a common preparation installation.

(Amended) 13. The process as claimed in claim 1, characterized in that the SO_2 (15) which forms in the slag-conditioning vessel (38) is fed to a gypsum or sulfuric acid installation.

(Amended) 14. The process as claimed in claim 1, characterized in that off-gas which forms in the slag-conditioning vessel (38) is collected, and the dust is enriched with ZnO contained in this gas.

(Amended) 15. The process as claimed in claim 1, characterized in that the conditioned slag (3) is cast, and the heat of solidification which is obtained during this operation is used in the preparation (21), for example in the drying and/or in the preheating of the metallurgical remainder materials (6), of the charge materials (22, 23) and process gases.

(Amended) 16. The process as claimed in claim 1, characterized in that the conditioned slag (30) is processed into blast-furnace sand, blast-furnace foamed slag or slag wood.

(New) 17. An installation for carrying out the process as claimed in claim 1, characterized in that the installation has a slag-conditioning vessel (38) for receiving metallurgical slags, (5, 7), and a heating device, a nozzle or a tapping opening (52) for conditioned slag melt (30) and a tapping opening (51) for an iron-containing melt (26), the slag-conditioning vessel (38) being equipped with charging and blowing apparatus for introducing metallurgical remainder materials (6) and additions (22), for blowing in reduction or carbonizing agents (23), and has additional bottom purging elements (48), such as porous purging bricks, which are connected to lines which supply a purge gas.

(Amended) 20. The installation as claimed in claim 17, characterized in that an electrical resistance heater is provided as the heating apparatus.

(Amended) 21. The installation as claimed in claim 17, characterized in that one or more lances (47), preferably submerged lances, are provided for the purpose of blowing in gases and/or solids, such as metallurgical remainder materials (6), and can be introduced into the slag-conditioning vessel (38).

APPENDIX B

VERSION WITH MARKINGS TO SHOW CHANGES MADE
37 C.F.R. § 1.121(b)(iii) AND (c)(ii)

CLAIMS:

Claim 3. The process as claimed in claim 1 [or 2] , characterized in that the converter slag is introduced into the slag-conditioning vessel (38) in the liquid state.

Claim 4. The process as claimed in claim 1 [one or more of claims 1 to 3], characterized in that the melting of solid charge materials in the slag melt, the introduction of energy for heat-consuming chemical reactions and the heating of the melts (26, 30) contained in the slag-conditioning vessel (38) to a suitable temperature are carried out by the introduction of electrical energy.

Claim 5. The process as claimed in claim 1 [one or more of claims 1 to 4], characterized in that the slag melt (30) contained in the slag-conditioning vessel (38) is oxidized in order to be desulfurized, preferably by blowing in oxygen and/or by blowing in an oxygen-containing gas, such as air.

Claim 6. The process as claimed in claim 1 [one or more of claims 1 to 5], characterized in that the metallurgical remainder materials (6) are added to the slag melt (30) in the slag-conditioning vessel (38) in the form of lumps and/or fine pieces.

Claim 7. The process as claimed in claim 1 [one or more of claims 1 to 6], characterized in that finely particulate metallurgical remainder materials (6) are blown into the slag melt (30) and/or the iron melt (26) below it at a low level, preferably lower than 2 m.

Claim 8. The process as claimed in claim 1 [one or more of claims 1 to 7], characterized in that finely particulate metallurgical remainder materials (6) and reducing agents (23) are blown into the slag-conditioning vessel (38) through a common delivery line and/or lance (47) by means of co-injection.

Claim 9. The process as claimed in claim 1 [one or more of claims 1 to 8], characterized in that the slag-conditioning vessel (38) is heated by means of electrical resistance heating.

Claim 10. The process as claimed in claim 1 [one or more of claims 1 to 9], characterized in that a layer of slag (30) which is over 1 m high, preferably from 2 to 5 m high, is maintained in the slag-conditioning vessel (38).

Claim 11. The process as claimed in claim 1 [one or more of claims 1 to 10], characterized in that the desiliconization slag (25) from the pig iron conditioning is introduced into the slag-conditioning vessel (38).

Claim 12. The process as claimed in claim 1 [one or more of claims 1 to 11], characterized in that the metallurgical remainder materials (6) from all operations in the metallurgical plant are prepared by screening, milling, drying and the like in a common preparation installation.

Claim 13. The process as claimed in claim 1 [one or more of claims 1 to 12], characterized in that the SO_2 (15) which forms in the slag-conditioning vessel (38) is fed to a gypsum or sulfuric acid installation.

Claim 14. The process as claimed in claim 1 [one or more of claims 1 to 13], characterized in that off-gas which forms in the slag-conditioning vessel (38) is collected, and the dust is enriched with ZnO contained in this gas.

Claim 15. The process as claimed in claim 1 [one or more of claims 1 to 14], characterized in that the conditioned slag (3) is cast, and the heat of solidification which is obtained during this operation is used in the preparation (21), for example in the drying and/or in the preheating of the metallurgical remainder materials (6), of the charge materials (22, 23) and process gases.

Claim 16. The process as claimed in claim 1 [one or more of claims 1 to 15], characterized in that the conditioned slag (30) is processed into blast-furnace sand, blast-furnace foamed slag or slag wood.

Claim17. An installation for carrying out the process as claimed in claim 1 [one or more of claims 1 to 16], characterized in that the installation has a slag-conditioning vessel (38) for receiving metallurgical slags, (5, 7), and a heating device, a nozzle or a tapping opening (52) for conditioned slag melt (30) and a tapping opening (51) for an iron-containing melt (26), the slag-conditioning vessel (38) being equipped with charging and blowing apparatus for introducing metallurgical remainder materials (6) and additions (22), for blowing in reduction or carbonizing agents (23), and has additional bottom purging elements (48), such as porous purging bricks, which are connected to lines which supply a purge gas.

Claim 20. The installation as claimed in claim 17 [one of claims 17 to 19], characterized in that an electrical resistance heater is provided as the heating apparatus.

Claim 21. The installation as claimed in claim 17 [one of claims 17 to 20], characterized in that one or more lances (47), preferably submerged lances, are provided for the purpose of blowing in gases and/or solids, such as metallurgical remainder materials (6), and can be introduced into the slag-conditioning vessel (38).

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Process for conditioning slags, and installation for this process

The invention relates to a process for conditioning slags and for recycling metallurgical remainder materials produced in the iron industry and to an installation for carrying out the process.

It is known to process blast-furnace slags further to form marketable products, such as for example pieces of blast-furnace slag for road building, blast-furnace sand, blast-furnace foamed slag, slag wool, etc. By converting the slag into a product of higher value, it is possible to further improve the profitability of slag reutilization.

For this purpose, it is known to adapt the properties of the blast-furnace slags to the quality demands of slag utilization, but all measures used to improve the slag products are subordinate to the requirements imposed on blast-furnace operation and on operation of the steelworks from a metallurgical and operational viewpoint.

It is scarcely possible to match the condition of the slag to the requirements of the following slag reutilization to such an extent that the blast-furnace slag can be used in its entirety and without loss of quality for the product, since most attention must always be paid to the quality of the pig iron or of the steel.

A particular problem arises from the slags which are still produced in the metallurgical operation, such as for example the electric furnace slag, converter slag, ladle slag, since, when viewed in isolation, these slags can only be conditioned for a product with difficulty and, moreover, are often only present in the solidified state, on account of the relatively small

quantities in which they are produced.

Furthermore, metallurgical remainder materials, such as metallurgical dusts, scale, metallurgical slurries, filter dusts, etc., present the metallurgist with problems if they are to be profitably exploited. Metallurgical remainder materials are often dumped without the materials of value - principally iron - which they contain being used profitably. If the materials of value contained in the remainder materials are recovered, this recovery generally takes place in the primary melting units, which represents an additional load on the unit. Moreover, the use of the metallurgical remainder materials in these melting processes requires complex preparation at various locations of the metallurgical plant, and consequently there is an enormous cost barrier to economical utilization of the metallurgical remainder materials, with the result that the metallurgical remainder materials often fail to be exploited to produce a product of higher quality.

The invention is based on the object of conditioning all the slags which are produced in a metallurgical plant, independently of iron or steel production, for further processing, and specifically without having to take account of the pig iron and/or steel quality. At the same time, it is intended for it to be possible to recover the metallurgical remainder materials, in particular the iron contained therein, without adding additional load to the iron or steel production processes and without increasing the operating outlay and outlay on equipment caused by preparation of the metallurgical remainder materials in a metallurgical plant. In particular, the intention is to avoid briqueting, pelletizing or sintering the remainder materials.

According to the invention, the solution to this object

is characterized by the following steps:

- combining and treating the slag from at least one tap of a blast furnace and/or from at least one tap of a melter gasifier used in a direct reduction process, in the liquid state, and other metallurgical slags, such as electric furnace slag, converter slag, ladle slag, from a steelworks and/or slag from a pig iron pretreatment in a slag-conditioning vessel,
- introducing metallurgical remainder materials, preferably all metallurgical remainder materials, such as metallurgical dusts, scale, metallurgical slurries (with the exception of pickling slurries), into the slag-conditioning vessel,
- blowing reducing agent, preferably together with finely particulate metallurgical remainder materials by co-injection, into the slag-conditioning vessel in order to fully react the substances which have been introduced, in particular to reduce the iron-containing remainder materials,
- introducing carbon in order to alloy the reduced iron from the iron-containing remainder materials,
- agitating the melts contained in the slag-conditioning vessel by blowing in purge gas via bottom purging elements of the slag-conditioning vessel,
- heating the melts contained in the slag-conditioning vessel to a desired temperature or holding them at a defined temperature,
- setting a desired composition of the slag melt contained in the slag-conditioning vessel by adding additives, such as lime, clay, quartz, bauxite, fine refractory material, etc.,
- tapping off the conditioned slag melt, and
- tapping off the iron-containing melt without any slag.

The iron content, the manganese content, and also the phosphorus content of the metallurgical remainder materials introduced into the slag-conditioning vessel collect in the pool of metal below the slag melt, which is brought into close contact with the slag as a result of the bottom purging. The introduction of reducing agents, primarily of carbon carriers, reduces the metals and causes them to descend into the metal melt, and the metal is alloyed as a result of the introduction of the carbon. On account of the migration of phosphorus into the metal melt and dephosphorization of the pig iron, which is then recommended, it is even possible for phosphorus-containing slags, such as converter slags, which hitherto had to be poured away, thus releasing their heat without it being utilized, to be exploited.

Preferably, slag from at least two or more taps of a blast furnace and/or taps of a melter gasifier are combined and treated in the slag-conditioning vessel. The larger the quantity of slag, the more profitably the slag conditioning can be carried out, since the introduced energy and raw materials can be utilized more efficiently. For this purpose, the tiltable or preferably fixed slag-conditioning vessel is designed to receive a very large quantity of slag, resulting in ideal buffering possibilities for receiving slags and remainder materials and for releasing conditioned slag.

The introduction of converter slag into the slag-conditioning vessel advantageously takes place in each case in the liquid state, since in this case the residual heat of the slag can be utilized. The energy required to melt solid converter slag is thus saved, with the result that the overall energy balance of the slag conditioning is improved. Hitherto, the Fe- and Mn-containing converter slag has being used partially as solidified pieces of slag in a sintering

installation, while most is poured away to obtain road building material, so that the heat of solidification is lost to the environment.

The melting of solid charge materials in the slag melt, the introduction of energy for heat-consuming chemical reactions and the heating of the melts contained in the slag-conditioning vessel to a desired temperature which is suitable for the further processing are advantageously carried out by the introduction of electrical energy, which advantageously takes place by means of an electrical resistance heater. The possibility of electrical heating means that the risk of the slag melt freezing on account of an excessively high melting point or of the slag temperature being to low, which would cause it to impede or interrupt the conditioning process.

Moreover, the addition of additives means that, in the three-material and four-material slag systems (CaO, SiO_2, Al_2O_3, MgO), there is a wide range of options for setting various slag specifications with regard to the hydraulic properties and vitreous solidification, with the result that a defined composition is specifically available at a defined temperature. Therefore, when using the slag for blast-furnace sand and subsequently for cement, it is possible, by establishing the correct condition of the slag, to considerably reduce the proportion of clinker in the cement and, in this way, to make a positive contribution with regard to cost and environmental aspects.

According to the invention, the slag melt contained in the slag-conditioning vessel is oxidized in order to be desulfurized, preferably by blowing in oxygen and/or an oxygen-containing gas, such as air. The SO_2 which is formed in the process can advantageously be supplied to a gypsum or sulfuric acid installation, resulting, during production of gypsum, in a high quality compared

to flue gas desulfurization gypsum.

According to a preferred embodiment, the metallurgical remainder materials are added to the slag melt in the slag-conditioning vessel in the form of lumps and/or fine pieces.

According to a further preferred embodiment, the finely particulate metallurgical remainder materials are blown into the slag melt and/or the iron melt below it at a low level, preferably lower than 2 m. The metallurgical remainder materials, as well as the other solids and gases which are to be supplied, are advantageously blown in through one or more lances, preferably submerged lances, which can be introduced into the slag-conditioning vessel. Complete reaction and dissolution of the material which is blown in is ensured if the lances have a penetration depth of over 2 m.

Advantageously, the finely particulate metallurgical remainder materials and reducing agents are blown into the slag-conditioning vessel through a common delivery line and/or lance by means of co-injection.

Advantageously, a slag layer with a height of over 1 m, preferably from 2 to 5 m, is maintained in the slag-conditioning vessel, enabling the gases and solids to be introduced deep into the slag layer in order to keep the off-gas as free from dust as possible and to ensure that there is a sufficient quantity of slag melt to rapidly dissolve the remainder materials and additions.

Preferably, the desiliconization slag from the pig iron pretreatment is also introduced into the slag-conditioning vessel for slag conditioning. The high SiO_2 content of the desiliconization slag is compensated for by the predominantly basic slag fraction in the conditioning vessel, where it

contributes to an improved viscosity.

Since their size and state means that not all metallurgical remainder materials are suitable for introduction into the slag-conditioning vessel, depending on requirements it is expedient for the remainder materials from all operations in the metallurgical plant to be prepared in a common preparation installation by screening, milling, drying and the like. In metallurgical plants, preparation devices for metallurgical remainder materials are currently scattered throughout various sectors for recycling, unless the materials are being landfilled. More economic preparation can be achieved by concentrating all the preparation steps at a single location in the metallurgical plant.

According to a preferred embodiment, the off-gas which forms in the slag-conditioning vessel is collected, and the dust is enriched with ZnO contained in this gas. The ZnO contained predominantly in converter dust and electric furnace dust is substantially discharged with the off-gas. Repeated, targeted recycling of the dust which is separated out of the off-gas from the slag-conditioning vessel leads to the dust being increasingly enriched with ZnO, until the ZnO content is high enough for further processing and the dust can be removed from the cycle or sold.

To further process the conditioned slag, this slag is, for example, poured onto water-cooled apparatus in order to produce blast-furnace sand. The heat of solidification which is obtained in the process is preferably utilized in the preparation of the metallurgical remainder materials, e.g. in the drying and/or preheating of the metallurgical remainder materials, of the charge materials and process gases.

The conditioned slag is preferably processed into

blast-furnace sand, blast-furnace foamed slag or slag wool, installations of this type expediently being directly linked to the slag conditioning.

An installation for carrying out the process is characterized in that the installation has a slag-conditioning vessel for receiving metallurgical slags, and a heating device, a nozzle or a tapping opening for conditioned slag melt and a tapping opening for an iron-containing melt, the slag-conditioning vessel being equipped with charging and blowing apparatus for introducing metallurgical remainder materials and additions, for blowing in reduction or carburizing agents, and being provided with bottom purging elements, such as porous purging bricks, which are connected to lines which supply a purge gas.

According to a preferred embodiment, the slag-conditioning vessel is of tiltable design, and the iron melt can be poured out via a siphon, whereas the slag melt can be poured out via a ladle lip.

According to a further preferred embodiment, the slag-conditioning vessel is of fixed design, it being possible for the iron melt and the slag melt to be tapped off separately via tapping openings by means of a slide/tap system.

Preferably, an electrical resistance heater is provided as the heating apparatus.

Advantageously, one or more lances, preferably submerged lances, which can be introduced into the slag-conditioning vessel, are provided for blowing in gases and solids, such as metallurgical remainder materials, with the result that these substances can easily be introduced very deep into the slag or metal melt.

The invention is explained in more detail below with reference to Figs. 1 to 4, in which Fig. 1 shows a diagram illustrating an operation of combined conditioning of pig iron/slags/remainder materials in a metallurgical plant, Fig. 2 diagrammatically depicts the process according to the invention in conjunction with the processing of pig iron/slags/remainder materials from Fig. 1 in detail as a block diagram, and Figs. 3 and 4 diagrammatically depict the installation according to the invention.

As shown in Fig. 1, in an operation 1 for conditioning pig iron/slags/remainder materials, all the pig iron 4 which is tapped from a blast furnace 2 and/or from a melter gasifier 3 and slag 5 which is tapped off is processed together with all the remainder materials 6 which are produced in a metallurgical plant, such as dusts, slurries, scale, refractory material, etc., which if appropriate may also originate from a different steelworks or from an existing slag landfill, and slag 7, such as converter slag, ladle slag, etc.; according to the invention, slags 5, 7 and metallurgical remainder materials 6 are conditioned together in a metallurgical vessel and, in addition, pig iron 4 is pretreated separately, in dedicated vessels, using processes which are known per se.

The pig iron 4, together with the iron originating from the slags 7 and metallurgical remainder materials 6, having been optimally conditioned, i.e. so that it is completely free of slag, has been desulfurized to a low level, if appropriate has been desiliconized and dephosphorized, with a precisely set temperature, with a precise weight and a defined C content, can be supplied at a desired time, as pretreated pig iron 8, to a converter 9 or other steelmaking apparatus, for example an electric furnace, from which it is fed, as finished steel 10, to a continuous-casting installation 11 and then to a rolling mill 12. Furthermore, it can

also, however, be conditioned for production of special pig iron 13, for example for ingots or granules, in order to increase the buffering capacity of operation between blast furnace and steelworks.

The primary products 14 which are produced in the operation 1 for conditioning pig iron/slags/remainder materials from slags 5, 7 and metallurgical remainder materials 6 by conditioning, such as blast-furnace sand, blast-furnace foamed slag and slag wool, as well as specially produced sulfur dioxide 15, are fed for further processing. For example, the primary products 14 can be used in the construction industry, for example for cement production, and sulfur dioxide 15 can be used to produce gypsum or sulfuric acid.

The P-rich slag 16 which is produced during the pig-iron conditioning in the operation 1 for conditioning pig iron/slags/remainder materials during the dephosphorizing of the pig iron 4 or only of the P-containing pool of metal from the conditioning vessel can be used to produce fertilizers. The P content of the slag 16 can be increased by reintroducing the slag 16 into the conditioning vessel.

All the liquid slags 5, 7, in particular blast-furnace slags 5, slags 5 from a melter gasifier 3 and slags 7 from the steelworks, such as converter slags, etc., are fed to the slag conditioning 17 illustrated in Fig. 2. As a result of the slags 5, and in part also the slags 7, being supplied in the liquid state, the energy which they inherently possess is made useable for the slag conditioning 17, and the conditioning process is accelerated.

The slag conditioning 17 is provided to deal with even large production quantities from a plurality of blast furnaces 2, converters 9, etc., the conditioning taking place in one or more vessels, advantageously in each

case for the slag volume from two or more taps for a blast furnace 2 and/or melter gasifier 3. This large volume of the treatment vessels represents an ideal means of conditioning and a very advantageous buffer in the flow of material.

The transport of the slags 5, 7 - as far as possible in the liquid state - from the location where they are formed to the location of slag conditioning 17 takes place, for example, by means of road transport in open ladles. Blast-furnace slag 5 and pig iron 4 can be transported in common vessels. Although the slag 5 is separated from pig iron by being poured off, it is acceptable for a small amount of pig iron 4 also to run into the slag-conditioning vessel. Steelworks slag 7 may contain a residual quantity of steel 10 (Fig. 1). The relatively small amount of steel 10 which is also carried in the steelworks slags 7 is incorporated in the pool of metal together with the amount of pig iron 4 which is also carried in the slag.

The pig iron 4 which has been separated from slag 5 is itself fed to a pig iron pretreatment, which always comprises desulfurization 20 and, if the entire pig iron is generally dephosphorized, also comprises desiliconization 18 and dephosphorization 19. By combining slag conditioning 17 and pig iron pretreatment 18, 19, 20 in a common operation, completely detached from the area of responsibility of the pig iron production and of the steelworks, it is possible to exploit considerable synergy effects, as described below:

Preparation 21, which may encompass both the metallurgical remainder materials 6 used in the slag conditioning process 17, such as dusts, scale, slurries, solid slags, etc., as well as additions 22 which are required for conditioning, such as lime, clay, quartz, bauxite, etc., and also reducing agents

23, in particular carbon 23, for the reduction and carburization of the metal pool which forms beneath the slag, takes place in a step which precedes the slag conditioning 17. If necessary, during the preparation 21 these substances 6, 22, 23 are subjected to drying and/or comminution, for example are milled, screened, mixed, etc.

For all the materials which are to be prepared, as well as the materials which have been prepared and those which can be used without preparation 21, storage 24, for example in silos, is provided in a storage facility, which allows targeted, controlled delivery of the materials, which are in the form of lumps and powder/fine pieces, to the conditioning vessel and to the pig iron pretreatment.

The metallurgical remainder materials 6, additions 22 and reducing agents 23 are fed from the store 24 to the slag conditioning 17. Charge materials 6, 22, for example lime, scale, etc., are also fed to the pig iron pretreatment steps 18, 19, 20 in order to build up a slag, the amount of which is advantageously sufficient for a plurality of pig iron treatments 18, 19 and, on account of the greater depth of the slag bath, facilitates operation with little splashing and smoke during the blowing-in operation involved in the desiliconization 18 and the dephosphorization 19.

The desiliconization 18 is the first step of the pig iron pretreatment 18, 19, 20 and includes the oxidation of a large part of the silicon contained in the pig iron 4, the desiliconization treatment being a known technique comprising the addition of gaseous and solid oxygen carriers, such as lime and the like. The desiliconization slag 25, which is enriched with SiO_2 over the course of the desiliconization 18 and the quantity of which may be increased in order to carry out a plurality of desiliconization treatments, can be

incorporated in the large overall volume of slag involved in the slag conditioning 17 without problems and can in this way be utilized. The "pig iron melt" 26, which is formed during the slag conditioning 17 from the iron-containing metallurgical remainder materials 6 and the iron-containing material which is introduced with the slag 5, passes in the opposite direction into a vessel for the desiliconization 18 and then, as pig iron 27 which has been combined with the pig iron 4 originating from the blast furnace 2 and/or the melter gasifier 3, passes through the further pig iron pretreatment steps 19, 20. However, it is also possible for the pig iron melt 26 from the metal pool in the conditioning vessel to be fed directly to the dephosphorization 19.

In the pig iron pretreatment steps 18, 19, 20 it is possible to work in a similar way to in the slag conditioning 17, i.e. with fixed or tiltable metallurgical vessels which are designed to receive a large quantity of pig iron and a large quantity of slag, preferably in each case to hold more than one converter charge weight and, moreover, are heatable. A siphon in the case of the tiltable vessel (Fig. 4) and a slide closure nozzle in the case of the fixed vessel (Fig.3) allow the pig iron 27 to be tapped off from the corresponding treatment vessel into a charging ladle completely without slag and therefore allow the contents of the ladle to be transferred into the next treatment vessel without any slag, so that the pig iron 27, after the desulfurization 20, can be supplied to the steelworks virtually without any sulfur, with little phosphorus, at a precise, even relatively high temperature and in a precise quantity and, on account of the buffering action of the large vessels, at a defined time as conditioned pig iron 8. It is also possible for a precise weight of slag to be sent with the pig iron 8 in a controlled way. For this purpose, slag is automatically drawn off from the higher tapping

hole or via a pouring lip of the metallurgical vessel. Special pig iron 13 for the production 28 of a solidified product 29, such as pig iron ingots or granules, can also be produced in a controlled way for the foundry industry.

The conditioned slag melt 30 is fed to a slag-processing installation for the production 31 of primary products 14, such as blast-furnace sand, blast-furnace foamed slag or slag wool; when producing blast-furnace sand by pouring the slag melt 30 onto water-cooled apparatus, a large proportion of the heat of the slag can be recovered and utilized, inter alia, in the preparation 21 for drying and preheating purposes. The production 31 is expediently linked to the slag conditioning 17. The primary products 14 which are obtained form the slag melt 30, such as blast-furnace sand, blast-furnace foamed slag and slag wool, are used as raw materials in the construction and cement industries. Some of the conditioned slag melt 30 can, if necessary, be processed to form slag 33 for use in a sintering plant by being poured off 32.

The SO_2 15 which is formed during the slag conditioning 17 as a result of desulfurization and the SO_2 15 which is produced during the desulfurization 20 of the pig iron 27 are advantageously used as raw materials for gypsum or sulfuric acid production 34.

The dephosphorization 19 which is carried out using a known technique uses a large vessel with large quantities of pig iron and slag. The large quantity of slag not only has the advantage of the high dephosphorization potential but also the advantage that gas-releasing solid oxygen carriers with little splashing and smoke formation can be blown in or added. To tap off dephosphorized pig iron 27 and slag 16 with a sufficiently high phosphorus content, tiltable ladle lips or, in the case of a fixed vessel, slide taps are

provided, through which the melts can be emptied into a ladle which rests in the ladle lift. The P-rich slag 16 which is produced during the dephosphorization 19 can, in a similar manner to the slag conditioning 17, be conditioned appropriately in terms of its composition and temperature for fertilizer production 35, which also avoids the need to landfill this slag 16. Liquid converter slags can also be used to build up the slag used for dephosphorization 19. The pig iron dephosphorization 19 allows the P-carrying converter slag to be recycled. The thermal and chemical (Fe, Mn) potential of the converter slag can be ideally utilized for the first time by means of the slag treatment/recycling/pig iron pretreatment synergy.

During the desulfurization 20 of the pig iron 27, a process using the Dr. MORE system, which is known for example from EP 0 627 012 B1, is used, in which the large volume of the synthetic desulfurization slag 36 is constantly regenerated as soon as the desulfurization capacity is too low and remains permanently in the vessel, with the result that only tiny specific amounts [kg/t of pig iron] of slag-forming agents are required for the desulfurization 20 to ensure that a precisely constant slag analysis is accurately maintained, and there is no need to dispose of the desulfurization slag 36. Furthermore, it is also possible for some of the desulfurization slag 36 to be used in a controlled way as slag in a ladle furnace during steelmaking. In this case, the entire ladle slag 37, together with residual steel 10, is returned to the desulfurization installation, preferably in liquid form.

The fixed slag-conditioning vessel 38, which is diagrammatically illustrated in Fig. 3, is suitable for receiving the slags 5, 7 and the metallurgical remainder materials 6, and has a base 39, a cover 40 and a side wall 41, is lined with refractory material

42 and is sufficiently insulated against excessive heat loss. There are a sufficient number of sensors 43 in the base 39 and in the side wall 41, providing notification of premature local wear to the refractory lining 42.

The size of the slag-conditioning vessel 38 is selected in such a way that a large quantity of slag 5, 7 can be accommodated, advantageously two or more taps from a blast furnace 2 and/or melter gasifier 3. The other remainder materials 6 and slags 7 from the metallurgical plant (steelworks slags, dusts, scale, etc.) can also be easily accommodated in this large volume.

The cover 40 has an opening 44 which can be closed if appropriate and through which slags 5, 7 which are in liquid form can be poured into the slag-conditioning vessel 38. These slags 5, 7 are delivered, for example, by means of road transport in well insulated ladles 45 which are lifted above the slag-conditioning vessel 38 and tilted for charging with the aid of a ladle lift which is equipped with a tilting and weighing device and a remote control feature.

The cover 40 also has an opening 46 for adding lumpy material 6, 7, 22, 23, such as for example coarse scale or lumpy slag. The material which is used to build up the conditioned slag is stored in silos, ready to be added or blown in, and is introduced pneumatically or by means of vibration shoots, conveyor belts, etc. with a controlled capacity. The material 6, 22, 23 which is to be introduced is added either in the form of fine pieces through the opening 46 or by blowing in powder/fine grains by means of one or more lances 47, preferably submerged lances, which project through the cover 40 of the slag-conditioning vessel 38, in mono-injection or co-injection mode, in which immersion depth, blowing capacity and blowing duration can be set

accurately.

In the slag-conditioning vessel 38, the slags 5, 7 form a slag melt 30 which has a height of over 1 m, preferably 2 to 5 m. Such a high slag melt 30 allows particularly deep introduction of substances 6, 22, 23 and gases via the lance(s) 47, which promotes the dissolution and reaction of the introduced substances 6, 22, 23 with the slag 5, 7 on account of the increased reaction distance. A pig iron melt 26, which is up to 2 m high and is formed as a result of reduction of the iron contained in the slags 7 or in the metallurgical remainder materials 6 by means of the reducing agent 23 which is blown in and by the introduction of residual steel 10 and pig iron 4 which is carried with it, is formed underneath the slag melt 30.

The base 39 of the slag-conditioning vessel 38 has bottom purging elements 48, for example porous purging bricks, which, by blowing in purging gas, intimately mix the slag melt 30 and the pig iron melt 26 and bring them into close contact with one another, leading to chemical and thermal balancing. The bottom purging elements 48 expediently have a setting which is optimum for full reaction of the materials which are blown in or of the substances 6, 22, 23 which are added to the slag melt 30.

Submerged electrodes 49, which form an electrical resistance heater, are used to maintain the molten state of the melts 26, 30 and to melt and dissolve the substances 6, 22, 23 introduced into the slag-conditioning vessel 38 and to set the temperature of the conditioned slag melt 30. It is particularly important to dissipate the thermal energy away from the submerged electrodes 49 during the resistance heating. Temperature-measuring devices 50 in the side wall 41 of the slag-conditioning vessel 38 monitor not only the

temperature of the slag melt 30 and of the pig iron melt 26 but also their height.

When the pig iron melt 26 is at a certain height, it is automatically tapped via a tapping hole 51 into a ladle 45 in the ladle lift and is fed to the pig iron pretreatment 18, 19, 20. In the case of a tiltable vessel 38′, the tapping hole 51 is a siphon 51′ (Fig. 4). In this way, the tapping, but also charging of the melts 26, 30 can take place independently of a crane. In the case of a fixed vessel, a further tapping opening 52 is provided for the slag melt 30 above the tapping hole 51 in the side wall 41, while in the case of a tiltable vessel 38′, the slag melt is emptied out via a lip 52′ on the opposite side from the siphon 51′. When the slag-conditioning vessel 38 is being completely emptied, for example for repair work, the tapping of the slag melt 30 likewise takes place via the tapping hole 51. Work on a slide system of the tapping openings 51, 52 can be carried out from a platform of the ladle lift.

To desulfurize the slag melt 30, oxygen or an oxygen-containing gas can be blown into the slag melt 30 via an oxygen lance 53 which projects through the cover 40 of the slag-conditioning vessel 38.

The off-gases which are formed during the slag conditioning 17 and during the recycling of the metallurgical remainder materials are extracted via an opening 54 in the cover 40 of the slag-conditioning vessel 38 and are fed to a dedusting installation or, in the case of desulfurization of the slag, to a gypsum or sulfuric acid plant. When reusing converter dust in the slag-conditioning vessel 38, it is possible to enrich the ZnO which is contained in the dust and is discharged with the off-gas, by repeatedly separating the dust separated out of the off-gas and blowing it back into the slag-conditioning vessel 38. The off-gas

system is designed in such a way that the CO which is formed during the reduction is burnt in a suitable way and that any Cl compounds which are liberated are burnt without dioxins being formed.

A lance 55 which is immersed mechanically into the slag melt 30 and pig iron melt 26 is available for sampling and as an additional temperature-measuring device. In the process, the temperature is measured and a sample is taken by means of probes fitted to the lance.

Fig. 4 shows a tiltable slag-conditioning vessel 38′ which is mounted tiltably on a shaft 56. To pour out the slag melt 30, the slag-conditioning vessel 38′ has a lip 52′ at an upper edge. Opposite the lip 52′ there is a siphon 51′ which projects upward from the side of the base 39′, is designed as a tube and via which the iron melt 26 is poured off without any slag. A metallurgical vessel 38′ designed in this way can also be used in the pig iron pretreatment steps 18, 19, 20.

The particular feature of the invention is that pig iron and slag are delivered from the blast furnace in common vessels, the separation taking place by tipping the slag into the slag-conditioning vessel, and also the common utilization of the preparation installation for the pig iron and slag treatment and the direct "disposal" of the slags which are produced during the pig iron treatment from the desiliconization and partially also from the dephosphorization into the slag-conditioning vessel, as well as the possibility of directly incorporating the metal from the reduction into the flow of pig iron.

The most significant advantages of the invention are listed again below:

- complete recovery of iron and manganese from all metallurgical remainder materials such as dusts,

slurries, solid slags, scale, refractory chips, etc.

- Converter and ladle slags are recycled in liquid form, with the heat being utilized. The problem caused by phosphorus in the recycling of the converter slag is solved by the invention.
- Utilization of significant synergistic effects by combining the conditioning of the entire quantity of pig iron and of all the slags from blast furnace and steelworks in a common operation, completely detached from the area of responsibility of blast furnace and steelworks.
- Ideal conditioning and buffering facilities result from large pig iron and slag melting units with an electrical heating facility.
- The very great bath heights in the fixed or tiltable vessels, as a result of blowing in at a low level, allow very environmentally friendly (no dioxins, etc.) and comprehensive recycling of all dusts and the like.
- The blast furnace or the melter gasifier is not subject to any stipulations with regard to pig iron and slag analyses. The steelworks may impose very specific demands with regard to analysis, temperature, quantity and delivery time of the pig iron.

Patent claims

1. A process for conditioning slags (17) and for recycling metallurgical remainder materials produced in the iron industry, characterized by the following steps:
   - combining and treating the slag (5) from at least one tap of a blast furnace (2) and/or from at least one tap of a melter gasifier (3) used in a direct reduction process, in the liquid state, and other metallurgical slags (7), such as electric furnace slag, converter slag, ladle slag, from a steelworks and/or slag from a pig iron pretreatment (18, 19) in a slag-conditioning vessel (38),
   - introducing metallurgical remainder materials (6), preferably all metallurgical remainder materials (6), such as metallurgical dusts, scale, metallurgical slurries (with the exception of pickling slurries), into the slag-conditioning vessel (38),
   - blowing reducing agent (23), preferably together with finely particulate metallurgical remainder materials (6) by co-injection, into the slag-conditioning vessel (38) in order to fully react the substances which have been introduced, in particular to reduce the iron-containing remainder materials (6),
   - introducing carbon (23) in order to alloy the reduced iron from the iron-containing remainder materials (6),
   - agitating the melts (26, 30) contained in the slag-conditioning vessel (38) by blowing in purge gas via bottom purging elements (48) of the slag-conditioning vessel (38),
   - heating the melts (26, 30) contained in the slag-conditioning vessel (38) to a desired temperature or holding them at a defined temperature,

- setting a desired composition of the slag melt (30) contained in the slag-conditioning vessel (38) by adding additives (22), such as lime, clay, quartz, bauxite, fine refractory material, etc.,
- tapping off the conditioned slag melt (30), and
- tapping off the iron-containing melt (26) without any slag.

2. Process as claimed in claim 1, characterized in that slag (5) from at least two or more taps of a blast furnace (2) and/or taps of a melter gasifier (3) are combined and treated in the slag-conditioning vessel (38).

3. The process as claimed in claim 1 or 2, characterized in that the converter slag is introduced into the slag-conditioning vessel (38) in the liquid state.

4. The process as claimed in one or more of claims 1 to 3, characterized in that the melting of solid charge materials in the slag melt, the introduction of energy for heat-consuming chemical reactions and the heating of the melts (26, 30) contained in the slag-conditioning vessel (38) to a suitable temperature are carried out by the introduction of electrical energy.

5. The process as claimed in one or more of claims 1 to 4, characterized in that the slag melt (30) contained in the slag-conditioning vessel (38) is oxidized in order to be desulfurized, preferably by blowing in oxygen and/or by blowing in an oxygen-containing gas, such as air.

6. The process as claimed in one or more of claims 1 to 5, characterized in that the metallurgical remainder materials (6) are added to the slag melt

(30) in the slag-conditioning vessel (38) in the form of lumps and/or fine pieces.

7. The process as claimed in one or more of claims 1 to 6, characterized in that finely particulate metallurgical remainder materials (6) are blown into the slag melt (30) and/or the iron melt (26) below it at a low level, preferably lower than 2 m.

8. The process as claimed in one or more of claims 1 to 7, characterized in that finely particulate metallurgical remainder materials (6) and reducing agents (23) are blown into the slag-conditioning vessel (38) through a common delivery line and/or lance (47) by means of co-injection.

9. The process as claimed in one or more of claims 1 to 8, characterized in that the slag-conditioning vessel (38) is heated by means of electrical resistance heating.

10. The process as claimed in one or more of claims 1 to 9, characterized in that a layer of slag (30) which is over 1 m high, preferably from 2 to 5 m high, is maintained in the slag-conditioning vessel (38).

11. The process as claimed in one or more of claims 1 to 10, characterized in that the desiliconization slag (25) from the pig iron conditioning is introduced into the slag-conditioning vessel (38).

12. The process as claimed in one or more of claims 1 to 11, characterized in that the metallurgical remainder materials (6) from all operations in the metallurgical plant are prepared by screening, milling, drying and the like in a common preparation installation.

13. The process as claimed in one or more of claims 1 to 12, characterized in that the SO_2 (15) which forms in the slag-conditioning vessel (38) is fed to a gypsum or sulfuric acid installation.

14. The process as claimed in one or more of claims 1 to 13, characterized in that off-gas which forms in the slag-conditioning vessel (38) is collected, and the dust is enriched with ZnO contained in this gas.

15. The process as claimed in one or more of claims 1 to 14, characterized in that the conditioned slag (30) is cast, and heat of solidification which is obtained during this operation is used in the preparation (21), for example in the drying, and/or in the preheating of the metallurgical remainder materials (6), of the charge materials (22, 23) and process gases.

16. The process as claimed in one or more of claims 1 to 15, characterized in that the conditioned slag (30) is processed into blast-furnace sand, blast-furnace foamed slag or slag wool.

17. An installation for carrying out the process as claimed in one or more of claims 1 to 16, characterized in that the installation has a slag-conditioning vessel (38) for receiving metallurgical slags (5, 7), and a heating device, a nozzle or a tapping opening (52) for conditioned slag melt (30) and a tapping opening (51) for an iron-containing melt (26), the slag-conditioning vessel (38) being equipped with charging and blowing apparatus for introducing metallurgical remainder materials (6) and additions (22), for blowing in reduction or carbonizing agents (23), and being provided with bottom purge elements

(48), such as porous purging bricks, which are connected to lines which supply a purge gas.

18. The installation as claimed in claim 17, characterized in that the slag-conditioning vessel (38') is of tiltable design, and the iron melt (26) can be poured out via a siphon (51'), whereas the slag melt (30) can be poured out via a ladle lip (52').

19. The installation as claimed in claim 17, characterized in that the slag-conditioning vessel (38) is of fixed design, it being possible for the iron melt (26) and the slag melt (30) to be tapped off separately via tapping openings (51, 52) by means of slide/tap systems.

20. The installation as claimed in one of claims 17 to 19, characterized in that an electrical resistance heater is provided as the heating apparatus.

21. The installation as claimed in one of claims 17 to 20, characterized in that one or more lances (47), preferably submerged lances, are provided for the purpose of blowing in gases and/or solids, such as metallurgical remainder materials (6), and can be introduced into the slag-conditioning vessel (38).

Abstract:

Process for conditioning slags, and installation for this process

To make profitable use of the slags (5, 7) and remainder materials (6) which are produced in a metallurgical plant, in a process for conditioning slag (17) and for recycling metallurgical remainder materials produced in the iron industry, the procedure is as follows:

- The slag (5) from at least one tap of a blast furnace in the liquid state and other metallurgical slags (7) from a steelworks are brought together and treated in a slag-conditioning vessel,
- Metallurgical remainder materials (6), preferably all the metallurgical remainder materials (6), and slag from a pig iron pretreatment (18) are introduced into the slag-conditioning vessel,
- Reducing agent (23) is blown into the slag-conditioning vessel in order to fully react the substances which have been introduced,
- Carbon (23) is introduced in order to alloy the reduced iron from the iron-containing remainder materials (6),
- The melts (26, 30) contained in the slag-conditioning vessel are agitated by blowing in purge gas,
- The melts (26, 30) contained in the slag-conditioning vessel are heated to a desired temperature or are held at a defined temperature,
- A desired composition of the slag melt (30) contained in the slag-conditioning vessel is set by adding additives (22),
- The conditioned slag melt (30) is tapped, and
- The iron-containing melt (26) is tapped without any slag.

(Fig. 2)

FIG. 1

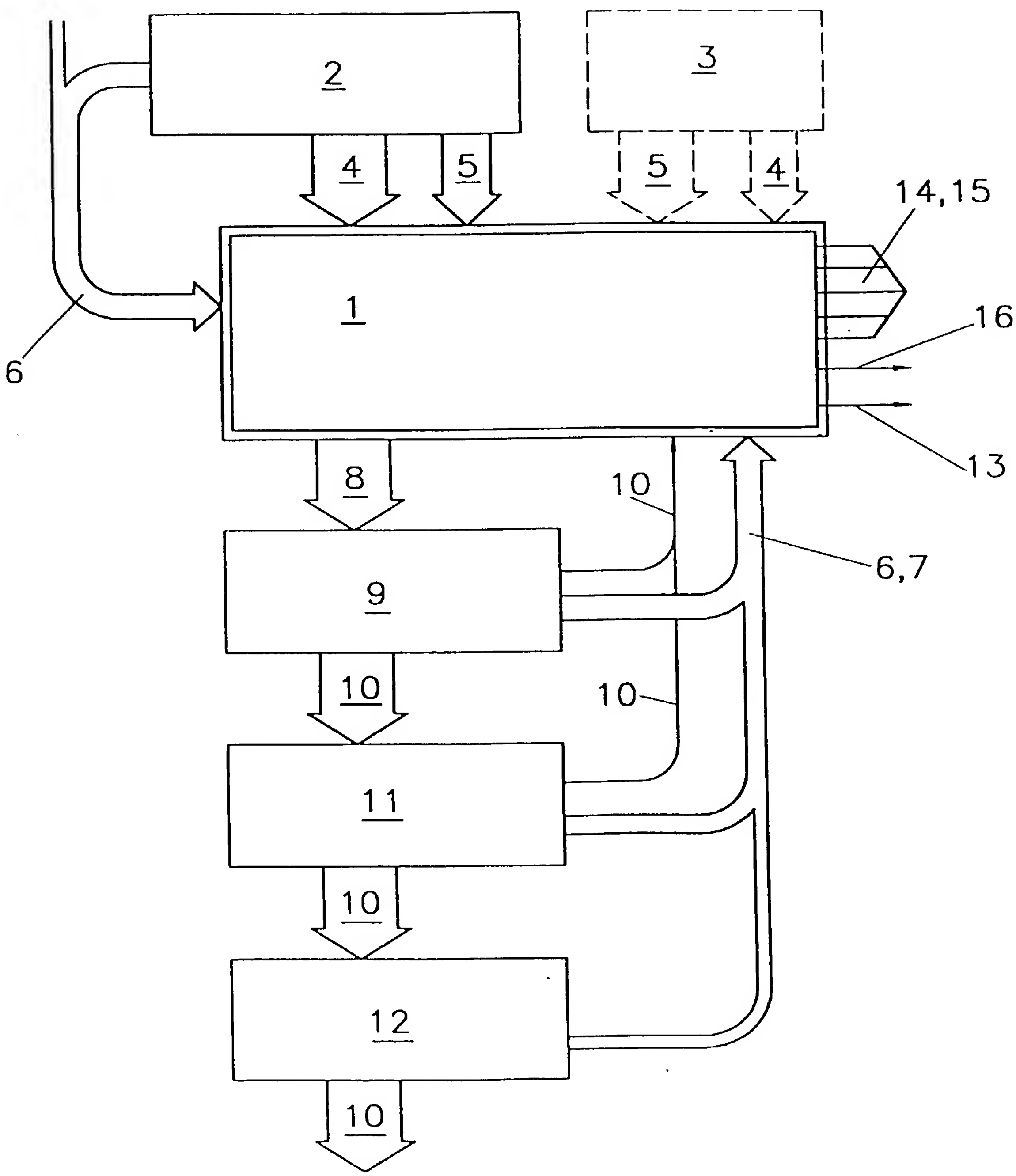
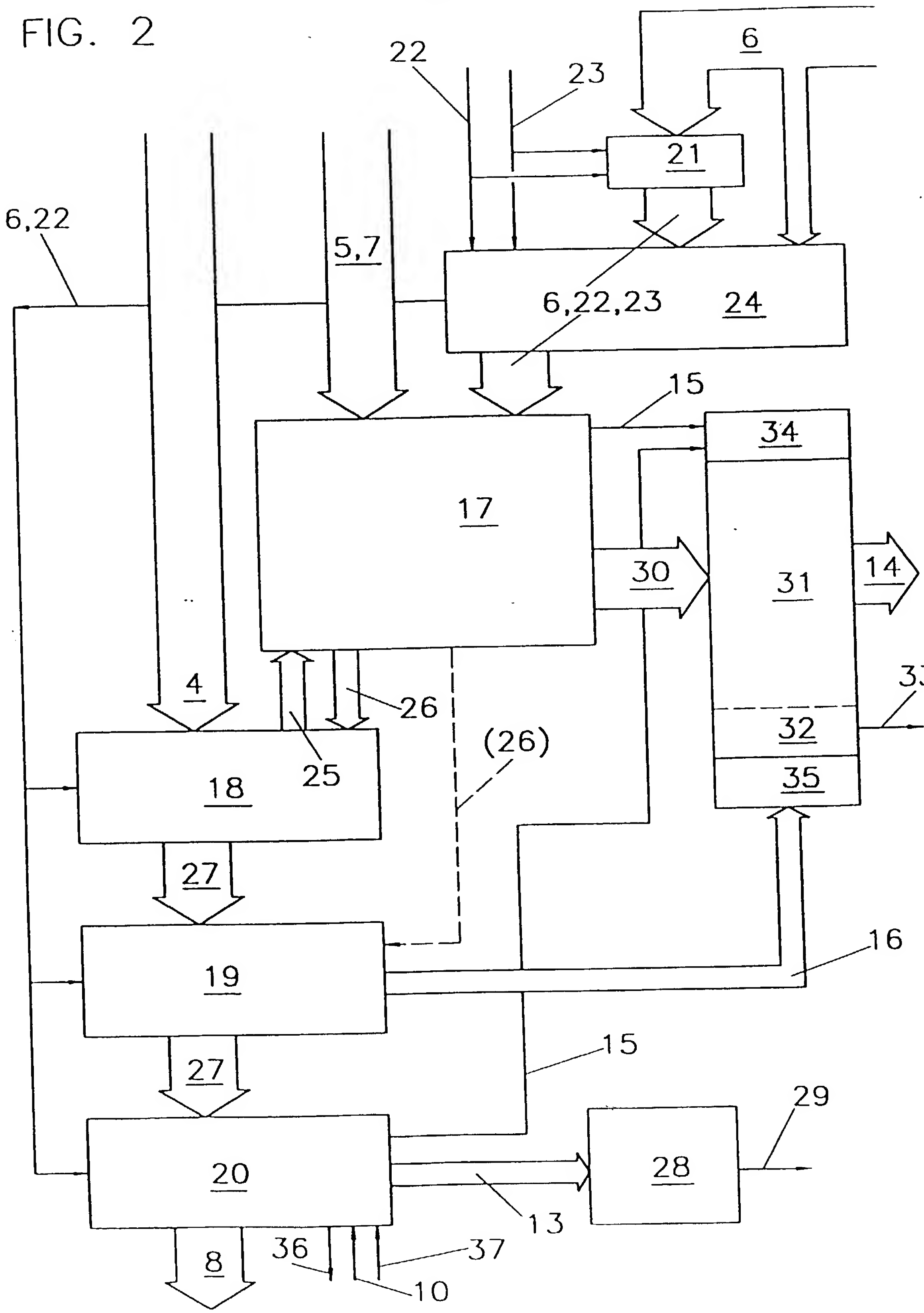


FIG. 2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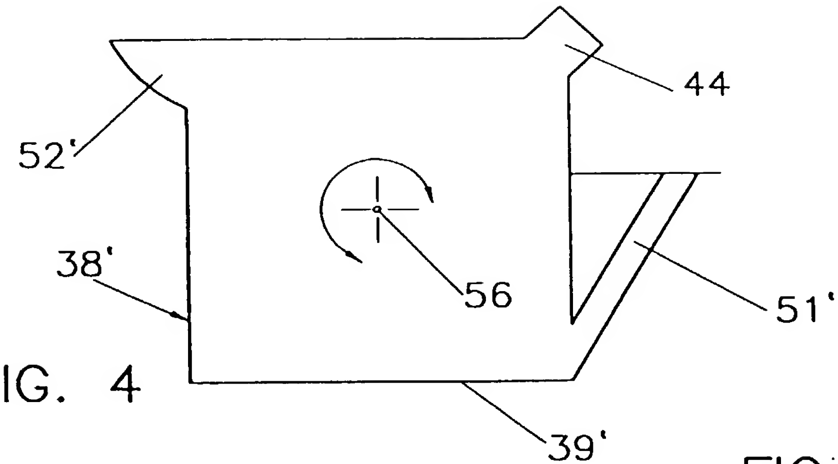
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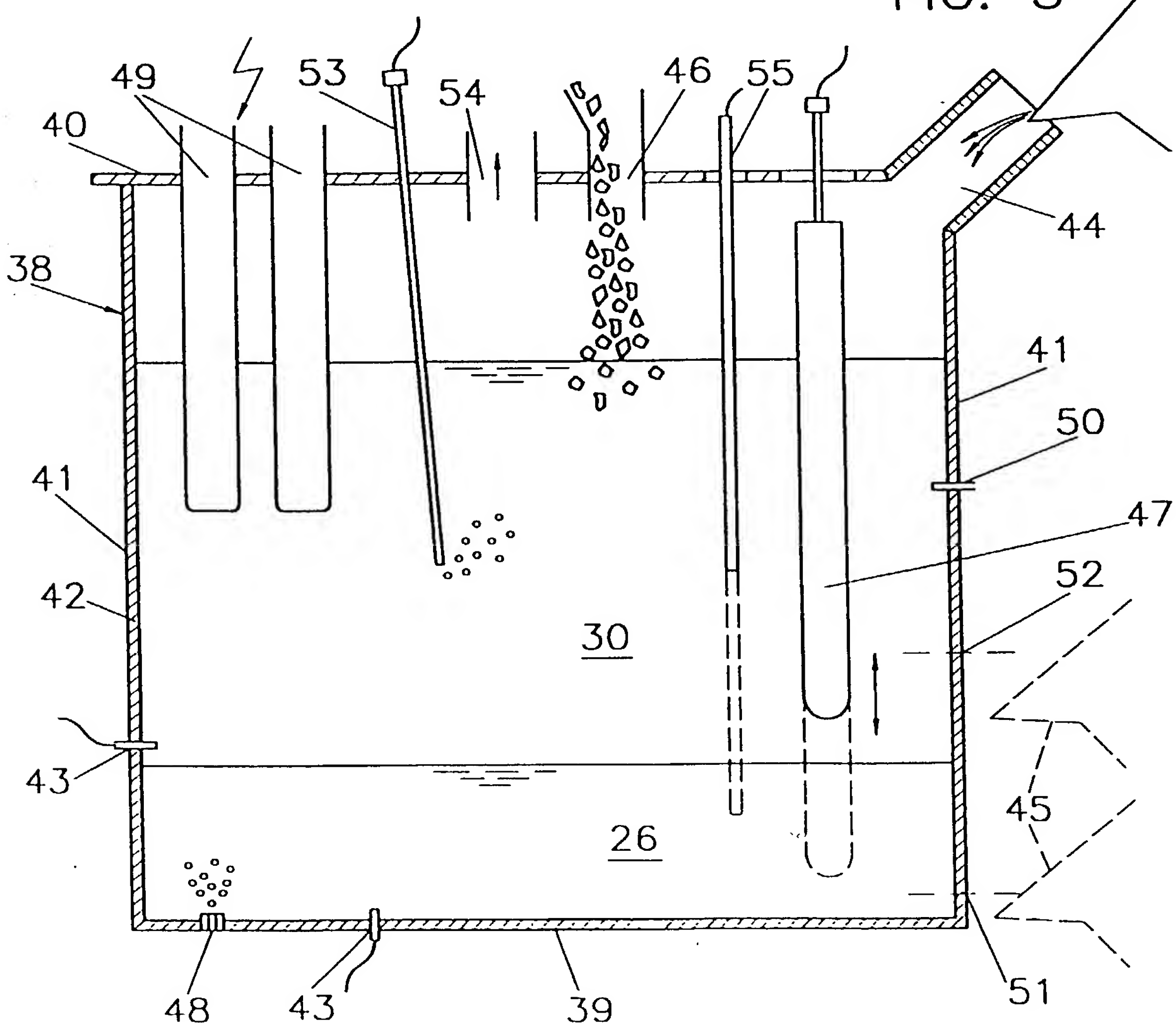
FIG. 4

FIG. 3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UNITED STATES OF AMERICA COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION	OFGS FILE NO. P/3240-65

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PROCESS FOR CONDITIONING SLAGS, AND INSTALLATION FOR THIS PROCESS

the specification of which is attached hereto, unless the following box is checked:

☒ was filed on May 12, 2000 as United States patent Application Number or PCT International patent application number PCT/EP00/04304 and was amended on March 7, 2001 (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate or United States provisional application(s) listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign or Provisional Application(s)

COUNTRY	APPLICATION NUMBER	DATE OF FILING (*day, month, year*)	PRIORITY CLAIMED UNDER 35 U.S.C. 119
Austria	A 1011/99	8 June 1999	YES XX NO ___
			YES ___ NO ___
			YES ___ NO ___

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

UNITED STATES APPLICATION NUMBER	DATE OF FILING (*day, month, year*)	STATUS (*patented, pending, abandoned*)

I hereby appoint customer no. 2352 OSTROLENK, FABER, GERB & SOFFEN, LLP, and the members of the firm, Samuel H. Weiner - Reg. No. 18,510; Jerome M. Berliner - Reg. No. 18,653; Robert C. Faber - Reg. No. 24,322; Edward A. Meilman - Reg. No. 24,735; Steven I. Weisburd - Reg. No. 27,409; Max Moskowitz - Reg. No. 30,576; Stephen A. Soffen - Reg No. 31,063; James A. Finder - Reg. No. 30,173; William O. Gray, III - Reg. No. 30,944; Louis C. Dujmich - Reg. No. 30,625, Douglas A. Miro - Reg. No. 31,643, and Michael J. Scheer - Reg. No. 34,425, as attorneys with full power of substitution and revocation to prosecute this application, to transact all business in the Patent & Trademark Office connected therewith and to receive all correspondence.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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APPLICATION INFORMATION

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Title Line Two:: ALLATION FOR THIS PROCESS
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